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PENETRATING RAYS FROM SPACE DISCOVERED BY MILLIKAN

The earth is being bombarded from all directions and at all times by rays more powerful, more penetrating and of shorter wavelength than even the X-rays and gamma rays from radium, until now the most penetrating radiations known to science.

This amazing discovery of what might be called super X-rays was announced to the National Academy of Sciences meeting at the University of Wisconsin on November 9 by Dr. Robert Andrews Millikan, director of the Norman Bridge Laboratory of Physics of the California Institute of Technology, Pasadena, California and winner of the Nobel prize for physics on account of his pioneer work in measuring the electron.

From out of space, born evidently in the great cosmic reaches of the universe, these newly discovered rays come to earth with a penetration at least a hundred times greater than the most penetrating X-rays which can be produced in our hospitals. Whereas X-rays can not go through half inch of metallic lead, it takes six feet of lead to completely absorb these cosmic rays which Dr. Millikan said are "harder and more penetrating than any which had before even been imagined".

Hearing Dr. Millikan was like being present when the Curies announced the discovery of radium, Roentgen reported the first generation of X-rays or Hertz sent the first wireless waves.

For he has discovered a new realm of the spectrum. The idea of a series of ether vibrations ranging from low frequencies of alternating electric current, passing through radio waves, heat, visible light, ultra-violet light and finally reaching the short wavelengths of X-rays and gamma rays of radium, is familiar to us. But far beyond these, approaching the abode of the infinitesimal, lies the region of the penetrating rays discovered by Dr. Millikan.

"Our experiments indicate that there is a region of frequencies as far above the X-ray frequencies as are these latter above the frequencies of light waves," said Dr. Millikan.

The wave length of the shortest of the "penetrating rays", as he calls them, is one-fiftieth of that of the hardest gamma rays from radium heretofore known and but one ten millionth that of ordinary light. And light has a wavelength, about one fifty-thousandths of an inch, which so far as everyday measurements go seems nearly the limit of minuteness.

Whence come these powerful rays?

Over five years of experiments which took Dr. Millikan and his assistants to the top of Pike's Peak, caused them to probe the upper atmosphere with marvelous featherweight instruments lifted by small balloons and carry on experiments sixty feet deep in a snowfed lake under the brow of Mt. Whitney proved conclusively that these penetrating rays do not originate on earth.

They are the result of transmutations of chemical elements taking place in the vast expanses of space. The gamma rays are produced only by nuclear transformations within the atoms of radium and thorium, in other words, when these elements disintegrate or are transmuted into other elements. Reasoning from such well known facts, Dr. Millikan concluded: that nuclear changes, that is, transmutations of elements, having an energy perhaps fifty times as great as the energy changes involved in known radioactivity on earth are taking place all through space. And the most probable sort of nuclear change is the capture of an electron by the positive nucleus of an atom. Thus the penetrating rays are signals of these cosmic transmutations sent to earth.

It is realized that these extraordinary rays detected by Dr. Millikan may be evidences of the actual construction of matter throughout all space. He suggests that they may be evidence for the condensation into matter out somewhere in space of the light and heat continually being radiated into space by the sun and stars. Our own sun dissipates into space each second some ten million tons of mass in the form of light.

It is a hopeful conception that in some other part of the universe this fundamental stuff and that emitted by all other stars is being synthesized into matter from which other worlds can be made. How much more cheerful this is than the disintegration that accompanies radioactivity.

The Millikan rays also probably affect vitally radio communication, for near the top of the atmosphere where they first impinge on the earth they help create the ionized conducting Kennelley-Heaviside layer of the atmosphere along which radio signals slide.

In fact the Millikan rays and the forces behind them may easily be one of the few universal fundamental laws or facts and may be in the same class with gravitation.

If the dream of the ages were accomplished here on earth and gold were made from mercury, the penetrating rays Dr. Millikan has discovered should be given off as a result of such a transmutation.

But to produce here on earth the penetrating rays Dr. Millikan estimates that the immense energy of ten million volts or more would be necessary and he holds out little hope of such an accomplishment. Consequently for the present at least the application of the penetrating rays to medicine and physics can not be anticipated.

Fortunately the amount of the penetrating rays reaching the earth is very small. Very delicate gold-leaf electroscopes were necessary in order to detect the rays in spite of their high penetration. The rareness of the rays is probably the salvation of life on earth for if the quantity were large the effect might be like being treated with very heavy doses of X-rays.

Unlike light or any other radiation from outer space the penetrating rays come to earth with equal intensity at all hours of day and night and with the same intensity in all directions. And when they strike the rocks on earth they stimulate softer rays whose discovery Dr. Millikan made as a by-product of the principal investigation.

Discovery of ultra X-rays is the climax of twenty years of search for the cause of a mysterious radiation. Two British physicists, Sir Ernest Rutherford and J. C. McClennan, noticed an unaccountable effect on their electroscopes in 1903, and the Germans tried to determine its cause by high balloon ascensions just before the World War.

Dr. Millikan's researches have extended over a decade, during which time he was assisted by I. S. Bowen, Russell Otis, and Harvey Cameron.

JUPITER TO SWALLOW UP EARTH

The ultimate fate of the solar system of which the earth is a part is that it will become two stars, one of them the sun and the other a new star made up of all the planets with Jupiter as a gathering point.

This is the prediction of Prof. W. D. MacMillan of the University of Chicago upon the basis of new mathematical studies reported . . in his paper to the National Academy of Sciences meeting at Madison.

Yet there is no need for immediate preparations for judgement day, for Prof. MacMillan estimates that it will probably be some five hundred billion years before Jupiter becomes a star and swallows the earth in the process of doing so.

The reason for this end of the solar system and its conversion into a binary or twin star is the the planets are actually growing, extremely slowly of course. They are sweeping up the cosmic dust or nebulosity throughout space somewhat as a snow ball increases in size and when the planets gather up enough matter they will be gobbled up by the largest of them due to the action of the laws of gravitation. The result is a star.

A large number of the stars in the heavens are binary and Prof. MacMillan considers it probable that many of them at one time were solar systems.

Looking so far into the future and into the past has greatly changed astronomers' ideas of the lifetime of a solar system. Whereas they used to think a solar system had a life expectancy of a mere hundred million years, Prof. MacMillan now estimates it at a million billion years, called for convenience an eon. Once an eon on the average a star will make a close approach to the sun, a event which would be explosively disastrous to our part of the universe whether it happened while the earth still existed or when the earth had long since disappeared in the clutches of Jupiter.

ULTRA X-RAYS DISCOVERY CARRIES ON WORK NEWTON BEGAN

About two hundred and fifty years ago, the great English scientist, Sir Isaac Newton, performed an experiment which started a new field of research. In his "Opticks", the first edition of which was published in 1704, he thus describes what he did: "In a very dark Chamber at a round hole about one third part of an Inch broad made in the Shut of a Window I placed a Glass Prism, whereby the beam of the Sun's Light which came in at that hole might be refracted upwards toward the opposite Wall of the Chamber, and there form a coloured Image of the Sun." This was the first artificially obtained spectrum to be studied by science, and, according tothe theory proposed by the Dutch physicist, Christian Huyghens, before the French "Academie des Sciences" in 1678, it was due to the fact that light consists of waves.

These waves, or vibrations in the ether, are much like waves in water, and the wave theory, which was not generally accepted until about a century ago, states that waves of different colors vibrate at different rates. The deepest red light that we can see vibrates about 375,000,000,000,000 times a second, while the violet light vibrations are about twice as fast. But these are not theonly kinds of radiations that exist. Vibrating more slowly than the red are the so-called infra-red, or heat, waves, which are copiously emitted by hot bodies and may be detected by such an instrument as the radiometer, invented by Sir William Crookes, often used as an ornament in optician's windows. On the other side of the visible spectrum are the ultra-violet rays, which vibrate more rapidly than the violet. These affect the films in our cameras, and also tan our skins, for it is their presence in sunlight that causes sunburn.

For many years this represented the extent of the known spectrum of radiation, but in 1888, Prof. Heinrich Hertz, at the University of Bonn, in Germany, discovered that if an oscillating electric current was discharged across a gap, it gave rise to what were later called Hertzian waves, in his honor, and which, in the hands of Marconi and others, made modern radio communication possible. The fastest vibrating of these have a frequency of about 450,000,000,000 per second, while the ones used in intercontinental wireless telegraphy vibrate as slowly as a hundred a second, and the waves may be a mile or more in length. Still longer ones could be produced if they were of any particular advantage.

The extension of the known spectrum in the other direction, among the rays of shorter wave length, or higher frequencies, than those in the ultra violet began in 1895, with Wilhelm Konrad Roentgen, at Wurzburg, Germany. He noticed that when he operated a Crookes tube, named after Sir William Crookes, its inventor, and consisting of a glass bulb exhausted of air in which a powerful electric discharge could be made, a nearby card coated with a special chemical preparation became luminous. He also noticed that the rays from the tube, which he called X-rays, because he did not know their nature, were stopped by solid objects like lead and iron, but were able to pass through wood and flesh. In 1912, Dr. Max Laue, of Zurich, proved that these Roentgen Rays are the same as light, vibrating more rapidly, and of much shorter wave length. Their frequency, or rate of vibration, may be as great as 25 billion a second, and their waves as short as a twenty-five billionth of an inch.

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wrapped in black paper, were given off from the mineral pitchblende. Two years later, in 1898, Pierre and Marie Curie discovered radium in this mineral, and the rays discovered by Becquerel are now known as the gamma rays of radium. The slowest vibrating are identical with the X-rays of the highest frequency, while some vibrate as fast as several hundred billion/a second. But even this was not the limit, for the new cosmic rays discovered by Dr. Millikan compare with the X-rays as the X-rays themselves compare with light, and the study begun with the simple experiment of Newton is ably carried on.

SLEEPING SICKNESS CARRIED BY CHANGEABLE GERM

The tiny organism that causes sleeping sickness, or encephalitis lethargica, and has mystified scientists since the first appearance of the disease in Vienna during the world war, has at last been definitely tagged and identified by Miss Alice C. Evans, of the U.S. Hygienic Laboratory. The organism belongs to the streptococcus group of bacteria. It varies so greatly in size that it can pass through one of the finest filters devised by science, and yet it grows so large at other times that it can easily be seen with the ordinary microscope.

The disease is not the same as the African sleeping sickness, that is caused by an organism carried by the tsetse fly. Encephalitis lethargica has been thought by some scientists to be due to the same organism that causes influenza, because it has followed influenza epidemics.

Miss Evans obtained the sample streptococci, with which she experimented, from the brain of a patient who had died of sleeping sickness at St. Elizabeth's Hospital for the Insane at Washington. The organisms were cultivated in test tubes and used to inoculate rabbits. The animals contracted the same disease, and after death the identical organisms were found in great quantities in the rabbit's brains. The disease was given to other rabbits by means of germs recovered from the brains of the ones that had died; this was continued until a succession of seventeen rabbits had been killed by the descendants of the original streptococci taken from the brain of the human case.

The organisms are not very hardy, and when kept for a long time under artificial conditions they lose virulence. Miss Evans also noted that when very small doses of strong streptococci were injected into rabbits they did not contract the disease immediately, and when they did so, it took a long time for them to die. In other words, small doses gave them a partial immunity.

Sleeping sickness has been more prevalent in the United States than is commonly believed. Altogether, since the appearance of the first case in 1918, not far from a thousand cases have been registered in cities with a total population of about 22,500,000. The disease causes irreparable injury to the brain, and patients who recover are generally mentally abnormal. The three cases that occurred in St. Elizabeth's Hospital for the Insane were of persons who had had an acute attack of the disease from four to six years before.

The fatality of the disease is about 30 per cent. and the surviving 70 per cent. have a sort of chronic case, some doctors maintain. Whether or not these cases are contagious and are able to spread the disease to others, has

not been ascertained, Miss Evans said.

The work of Miss Evans in definitely identifying the causal factor of sleeping sickness will enable future investigators to continue experiments which it is hoped will lead to the discovery of a preventive or cure.

NEW CLAIM FOR DISCOVERY MISSING ELEMENT 75

The missing chemical element number 75 has been discovered by Dr. J. Heyrovsky, professor of physical chemistry of Charles University, Prague, and Doctor Doleysek of the Prague Academy of Sciences, according to reports coming through London.

The element has been named bohemium, in honor of Boehmia, and was discovered as an impurity in the well known metal magnesium through the use of the mercury drop electroscope.

Prof. Heyrovsky was a pupil of the famous English chemist, Ramsay, who discovered several elements, including argon.

Element 75 has heretofore been known only by its number or order in the table of elements arranged according to their atomic structure.

The discovery of element 75 is also claimed by Prof. Walter Naddack of the University of Berlin working with Otto Berg and Ida Tacke. On June 17 a Science Service dispatch from Berlin told how they had identified both numbers 43 and 75, known to be closely related, through the use of X-Ray analysis and spectra. They selected the names, rhenium and masurium, as the elements 75 and 43, respectively, in honor of regions lost to Germany as a result of the war.

From the arrangement of the chemical elements based on laws developed by Moseley, the English physicist killed at Gallipoli, the properties of missing elements can be predicted. From such theoretical evidence it is known that elements 43 and 75 should be closely related and that they should also have physical and chemical properties allied to manganese.

If one or the other of the two claimants for the honor of occupying niche 75 in the array of fundamental stuff of the universe is successful, and if element 43 has been discovered as claimed, only three missing chemical elements will remain to be discovered. These are numbers 61, 85, and 87.

CATHODE RAYS MAY BE USED TO KILL GERMS

Cathode rays, formerly produced within glass vacuum tubes by the discharge of heavy electric currents, can now be produced in the air in such quantities as to kill bacteria and insects, and cause other striking physiological and physical effects, by means of an apparatus developed by Dr. W.D. Coolidge of the General Electric Company, and described by him in "Science". Dr. Coolidge, inventor of the Coolidge X-ray tube now in general use in hospitals and laboratories, uses a tube of very high vacuum, with the discharge made from an

electrode within it, which is heated by another electric current. At one end of the tube is a "window" of thin aluminum, as large as three inches in diameter, which keeps the air from getting into the tube, but which permits the cathode rays, consisting of rapidly moving electrons, to pass outward.

With a potential as high as 250,000 volts, and a current of several thousandths of an ampere, the rays travel as far as 18 inches from the tube, and produce a purplish glowing of the air in front of it. Crystals of calcite, a mineral similar to limestone, glow with an orange light when placed in the path of the rays, and continue to do so for several hours after the exposure has ended. "In addition to this," says Dr. Coolidge, "they may show bluish white scintillations. These have been observed while the crystal is undergoing bombardment and for as long as a minute after raying. By slightly scratching the rayed surface of the crystal, the scintillations may be produced for as long as an hour after raying. Under the microscope, the spot where the scintillations took place is marked by a little crater with many tiny canals leading into it."

Pronounced chemical effects are produced by the rays. For example, castor oil is changed very quickly to a solid substance. The most striking effects, however, are produced on living things. "Bacteria," says Dr. Coolidge, "have been rayed, and an exposure of a tenth of a second has been found sufficient to kill even highly resistant bacterial spores. Fruit flies, upon being rayed for a small fraction of a second, instantly showed almost complete collapse, and in a few hours were dead." This may lead to the application of the rays as a powerful germicide and insecticide, but that their promiscuous use would be of considerable danger is shown by their effect on higher forms of life.

"The ear of a rabbit was rayed over a circular area one centimeter in diameter for one second," Dr. Coolidge continues. "After several days a scab formed which fell off a few days later, taking the hair with it. Two weeks later a profuse growth of snow white hair started which soon became much longer than the original gray hair. Another area was rayed for 50 seconds. In this case scabs developed on both sides of the ear, which later fell out leaving a hole. The edge of this hole is now covered with snow white hair."

The general design of the present apparatus seems to indicate that it would be possible to use still higher currents, says Dr. Coolidge. However, the relatively short range of the rays makes it seem that the apparatus cannot be used as a "death ray" in warfare.

"HUMAN HUSK" CASE RECALLS SIMILAR CUSTOMS OF ANCIENTS

Society's right to dispose of "human husks" is a prerogative claimed by many groups from ancient Greeks to present day Eskimos, historical and anthropological studies show. Moreover, to "human husks" have often been added those incapacitated by infancy, old age or illness.

The Chinese, for instance, were especially apt to dispose of girl babies, a practice which increased in times of famine, and persisted down to the last century. The philosophy which justified their stand came in part from Confucius, who wrote, "A son has received his life from his father and his mother, and this gives them rights over him that are above all others".

The Greek custom, adopted also by the Romans, of exposing children who were weakly or deformed at birth, is well known and was part of a general philosophy that the father had power of life and death over his children.

Among primitive people, at least until recently, numerous cases of infanticide in general as well as of the death of deformed children - always approved by the entire group - have been brought to light by investigators. Among certain tribes in Africa, in the Philippines, and in other of the Pacific Islands, one of a pair of twins was always killed, partly from the superstition that an evil spirit had fathered one twin and partly because in a battleless country the nursing of two infants overburdens the mother. In other places, where life was hard, girl babies were killed, as of less future use than boys.

Among the Ashanti natives in Africa, a living baby whose mother died at its birth was buried with the mother, the idea seeming to be that the child belonged to the mother. In some places, West Africa among others, a child was killed if the omens at its birth were wrong. In Australia, one investigator found, "all sickly or deformed children are made away with in fear of their becoming a burden to the tribe," while in Australia also arose a case of two deaf children in which the "death penalty" was withheld only because of the British law.

In most of these cases there is great similarity on three points; the child is killed immediately after the birth and before the naming ceremonies by which the child is recognized as human and a member of the tribe; the killing of the children has supposedly a direct relation to the welfare of the tribe as a whole; and the entire tribe concurs in the custom and regards it as proper.

Akin to infant killing among early historic and primitive groups is the killing or voluntary suicide of the aged. On the Greek island of Ceos, before the Christian period, it was customary, if not compulsory, for people who had passed the age of sixty to drink poison hemlock. In some parts of Melanesia, until very recent times, aged and sick people have been buried alive, but, says one man who lived among them, "it is certain that when this was done there was generally a kindness intended," and the sick and aged usually acquiesced in the practice. The same custom prevailed until very recently among the people of the frozen north of Siberia, while a missionary among the Eskimos reported that when a young Christian convert was asked what kind deed she had done one day, she replied, "I led an old blind woman to the cliff that she might throw herself over."

It was only after the rise of Christianity, philosophers tell us, that human life became so precious that every scrap of it must be saved, and it is mainly where Christianity has spread that, with increasing ease of livelihood, the individual life takes precedence over the group.

As Christianity fought against the established custom of killing sickly infants, so now, here and there, appear little movements to again change custom and again bring about control by society over its offspring, either by controlling marriages or permitting the incurable to be disposed of. But cautious men point out the difficulties of finding a safe criterion of judgment of the fit and unfit, especially for borderline cases. Dr. John Langdon-Davies, English anthropologist, calls attention to the fact that Byron, Keats, Darwin, Julius Caesar, St. Paul and Dostoievski were all invalids and the last three epileptics, while Calvin, Newton, Heine, Voltaire, Herbert Spencer, and Robert Louis Stevenson would all have been exposed at birth according to early Spartan principles. He says, "In other words history is packed with examples

where eugenic interference would have impoverished the world beyond repair, and we might almost regard the money spent in maintaining the unfit as a sort of insurance premium against the dangerous losses of the other policy."

NEW CANADIAN METHODS MAY REVOLUTIONIZE COLD STORAGE

Improvements in refrigeration methods which may result in widespread changes in systems of storing and shipping perishable foods are being put into effect by a group of shipping experts, fish distributors and officials of the Atlantic Experimental Station for Fisheries of the Canadian government.

The central idea of the new method is that foods preserved by freezing should be chilled rapidly instead of slowly, as has been the practice in the past. Filets of large fish are wrapped in waxed paper and packed tightly in narrow cans, sunk in a rapidly circulating bath of very cold brine, kept constantly at a temperature near zero Fahrenheit. Small fish are wrapped and packed in whole. This process freezes the fish rapidly, preventing the formation of large ice crystals which occurs when the chilling proceeds at a slower rate, and which is very deleterious to the fish when kept for more than a few days. Fish preserved by the new rapid freezing method have been kept for six months, and when thawed and cooked could not be distinguished from freshly caught fish.

Still more rapid methods of freezing are being sought by the experimenters. Pieces of haddock were hung on wires and submerged in liquid air, kept in big thermos bottles, which furnished a temperature of some 300 degrees below zero Fahrenheit. At once the liquid boiled and hissed like water when a white hot iron is plunged into it, and in a fraction of a minute the fish was taken out, frozen white like one's ear in a blizzard, and brittle as taffy. There was no moisture on the flesh, no slime, no crystals of ice in the tissue.

Liquid air freezing is still too expensive for commercial use, but the price of the cooling agent could be reduced to a few cents a quart, refrigerating engineers claim, if the fish industry were to adopt the technic widely, since the manufacture of liquid air on a large scale for this purpose would bring a lower price.

The use is being considered also of solid carbon dioxide, the soda-water gas, which is more easily handled than liquid air but not so cold. Seventy degrees below zero Fahrenheit is the melting point of carbon dioxide, and like liquid air it gives a dry, pure cold.

ATHLETIC "CONDITION" NO BAR TO INFECTION

The commonly accepted idea that good physical condition is a safeguard against infection from disease germs has received somewhat of a blow from the results of experiments carried out by the late Dr. Reynold A. Spaeth in the laboratory of the Johns Hopkins School of Hygiene and Public Health. Dr. Spaeth found that female white rats which were "in training" as a result of exercise resisted one type of pneumonia infection less well than control rats kept in restricted quarters, where exercise was impossible. It is as yet too early, Dr.

Spaeth felt, to advance any theory in explanation of this unexpected situation. The experiments, however, dispose of a suggestion that had been brought forward to account for the results of some earlier work on the same public health problem - the relation between physical condition and resistance to infection.

In a series of earlier experiments from the same laboratory it was found that, in both guinea pigs and white rats, animals that had been fatigued to the point of exhaustion by forced running in motor-driven drums resisted infection more successfully than rested, unfatigued animals. It was suggested that the exercise, even though carried to what from the animals' point of view was certainly excessive lengths, was responsible for the higher resistance. The experiments on white rats, where the animals ran spontaneously many miles and were in the pink of condition and yet failed to resist the infection as well as the controls, made that theory untenable.

It is of interest to note that among white rats the female is the more strenuous sex. The males were so slothful that they were finally eliminated entirely from the experimental cages. They persisted in behaving merely like an extra set of controls. The most active female ran nearly one thousand miles while the least active male ran during the same time less than one thousand feet. Female white rats run farther and are more active in the presence of the males, but even after the latter had been eliminated from the experimental cages, the females' performance still entitled them to be called "athletes" in contrast to the inactive controls - and the lazy males. And these athletes were less able to cope with infection than the sedentary males.

Experimenting next with guinea pigs Dr. Spaeth sought for an answer to the query: why are athletes so fragile? Going over the results of these experiments, he was forced to the curious conclusion that these animals owed their resistance to infection neither to exercise nor to fatigue but to the fact that they were in a temporarily starved condition. The exhausted guinea pigs, which withstood infection better than the well-fed controls, lost as much weight during the hours in the motor-driven drums as though they had been partially starved for several days. Guinea-pigs, like all herbivorous animals, eat or at least nibble almost all day and all night. Unless herbivorous animals can get concentrated food-stuffs in the form of grain, they have to keep feeding most of the time in order to get enough to eat. Unlike white rats, guinea pigs recover from fatigue by feeding, not by sleeping. Just as soon as they are able to drag themselves to the food-troughs, they feed ravenously, rapidly regaining their normal weight. An analysis of the results of the earlier experiments showed that whenever an experimentally infected guinea pig gained weight on the day after infection, that animal lived. The converse was not invariably true - that is, many animals lost weight and still recovered; but among those who succumbed to the infection there was not one that had gained weight the day after infection.

FROZEN WATER PIPES THAWED BY ELECTRICITY

There is no longer any need to crawl under the house with paper and kindling wood to thaw out the frozen water pipes, and risk burning the house down or suffocating. A German electrician suggests a means of thawing them out with electricity. The ordinary house current is reduced to voltage that is not excessive by means of a transformer, and then it is sent through the frozen section of water pipe. The heat produced by the current will melt the ice.